Pushing the Limits beyond Catalogue Raisonnée: Step 1. Identifying digitalization challenges in museums

Maija Ekosaari
Tampere University of Technology, Finland
Maija.Ekosaari@tut.fi

Samuli.Pekkola
Tampere University of Technology, Finland
Samuli.Pekkola@tut.fi

Abstract

Museums collect and preserve natural and cultural heritage. Although contemporary information systems are used for managing and exhibiting collections, they have been designed from the viewpoint of supporting practices and methods from the renaissance period. This makes digitizing and innovating new services challenging. In this paper, we focus on the first step in developing digital services in museums and conduct a two-part exploratory survey on 58 experts (directors, collection and exhibition curators, IT experts) to understand their perceptions on different challenges of digitizing, innovating and creating e-services. The experts first identified different IS related challenges and then selected the most significant ones. Our findings thus provide insights not only about the challenges but also show how their perceived importance vary between the expert groups. These insights help researchers and practitioners to study and develop methods and means to digitize and innovate in museums and other organizations with very long traditions, and thus, with strong culture of doing things in an old way.

1. Introduction

Museums seek to collect and preserve natural and cultural heritage and convey the understanding of their collections to various audiences. Since 1960's, the traditional methods, originally from the renaissance period, of organizing and accessing museum information have gradually changed into digital access catalogues [1, 2]. Yet, currently many museum information systems (IS) are merely presenting earlier information in electronic format. This means the artefacts' digital representations are as prone to information problems, such as poor quality, incomplete information, and lack of context, as are their physical counterparts.

Similarly to any organization, digitalizing museums' different activities and functions can be seen as a precondition for innovating new e-services. As the first step on this journey, an understanding about the challenges what may influence and even hinder the digitization endeavors is needed.

We focus on the digital collections management systems in museums for several reasons. First, they are an expensive investment and when committing to one, museum is likely to live with it for a decade, if not longer [3, 4]. Second, digital collections management systems provide vital support to all information processes in museums [5]. Third, the systems aren't only used to manage the cultural heritage information but also to collect, create, ingest, and disseminate it. In other words, they cover a large portion of activities taking place in the museums.

In museums, where the focus is hundreds of years instead of a quarter, careful balancing is required when embracing new technology and innovative services. This focus on long-term preservation sets diverse and often conflicting information needs [6]. Also, the more individuals and governments are advocating for open access to the information created on public money, the more the demand for visual and cultural content increases [7]. How can museums satisfy such a demand with their existing ways of working?

To answer this need, we take the first step and study *how the museums' current collection management systems support digital service creation, and what are the main challenges there*. In order to understand museums and their challenges, we conducted a two-part qualitative survey among museum experts. Altogether 58 experts (directors, collection and exhibition curators, IT experts) first identified different IS related challenges and then selected the most significant ones. Our results show that the challenges vary between the groups of experts, although information accessibility and legal issues are common. Comparing our findings to the literature [5, 8] reveals commonalities between museums and other domains, but also reveals some museum specific challenges.

The paper is organized as follows: First we present related research and summarize the background. Then we describe research methods and settings. After reporting our findings, they are reflected to the literature and discussed thoroughly.

URI: https://hdl.handle.net/10125/59753
ISBN: 978-0-9981331-2-6

2 Background and related research on museums and IS

Digitizing cultural heritage is a precondition and a driver for digitalization and developing digital services. Digitizing stands for converting previously analog information into digital format or creating and capturing digital-born material of museum collections and its functions. Digitalization instead, a technological paradigm shift, is a process of integrating digital technologies into all aspects of life by digitizing everything that can be digitized.

The literature suggests that many of the general innovation challenges are challenges also when digitizing cultural heritage. They include, for example, lack of resources [9-11], insufficient training [10, 12], technology [13], and organizational culture [14, 15]. Innovation and digitalization have long been seen as being essential for organizational competitiveness and success [16, 17]. Over the past years, the importance of digitizing cultural heritage in the memory institutions, such as archives, libraries and museums, is recognized, as digitizing has several benefits. It improves the access to the objects making it easier to find and observe them by museum professionals, scholars, and the general public. Secondly, digitization reduces the use of the physical artefact thus helping their long-term preservation [18, 19]. Thirdly, there is positive publicity and increased understanding of the work museum [20, 21].

Organization's ability to innovate and manage them is influenced by a number of factors. Those include management and leadership, resources, organizational structure, technology, knowledge management, corporate strategy, employees, innovation process, and ultimately, organizational culture [8]. We will next discuss these factors in the context of museums.

It has been suggested that many issues hindering innovation are challenges also in digitizing cultural heritage [11, 19, 22]. For example, project management issues, such as understanding the complexity of museum documentation, its digitization projects and evaluation of the completed projects, are significant factors also in museums [23, 24]. Digitization puts new requirements to the skills and competencies of its employees [25, 26]. Liberal arts education, traditionally valued in the museum field, has little emphasis on planning and managing projects, negotiating contracts, or implementing new technologies [27, 28].

Political realities, national and regional policies, and political decision-making can change rapidly, and, change the funding focus [5, 13]. Therefore, little control over the level of public funding or small unbudgeted changes in project costs, that would be easy to cover in the industry, may actually be unsurmountable [2]. Brancolini [22] and Anderson [29] offer a break-down of digitization cost structure. Riley-Reid [9] pursues to understand the hidden costs of digitization and how they accrue.

Technology-related literature about museums is narrow in terms of scope and depth. Chenhall and Vance [30] and Sarasan and Neuner [2] bring up different technical issues when digitizing the cultural heritage. In addition to digitalizing administrative processes, technology is also seen as means to enhance visitor experience in exhibitions and of accessing information on-line [31, 32]. However, as Bell [13] remarks, technology can also hinder digitization when there is a need to balance with political realities, existing infrastructure, and less than optimal technical solutions.

Large amounts of rich digital content and very diverse audience is a challenge [33, 34]. How these can be linked, urges for interoperability between the systems. [35, 36]. Non-existing metadata standards, vague information management policies and lack of skills and competencies lead to poor systems interoperability [37]. Methodological frameworks [24, 38], conceptual data models [7], and the use of semantic web technologies are attempts to structure the museums' information [39, 40].

In response to the demand for open access, museums have found legal issues particularly challenging. Owned and funded by the state and municipalities, several laws define not only the tasks and duties of museums, but also procedures they need to comply to, for example, when procuring new technology. Legal issues are identified as being the major challenges for digitization [5, 9, 15]. In addition to the copyright law, intellectual property and data privacy laws can greatly complicate digitizing of analog information. According to Akmon [15], clearing the rights and asking for permissions can consume up to 85% of the time in a digitization project. He also notes that risk-adverse organizational policies can prevent the publication and use of the digitized items.

Organizational culture encompasses many of the previously identified challenges [5, 15]. It has been identified as the most common factor related to an organization's ability to manage innovations [8]. This parallels findings that external factors, such as government policy and legislation, are often beyond the control of a company [10, 41]. Organizations with long history and traditions tend to maintain their existing ways of actions. These traditions can easily turn into serious challenges.

The development of digital services poses challenges that are not necessarily technical. For example, Peffers et al. argue for common understanding and interpretation of artifacts, objects, objectives, processes, and methods in collaborative service development [42]. Multiple viewpoints of customers and service providers [43] and the importance of business models support [44]

emphasize effective communication between all stakeholders and favorable organizational culture. Again, these challenges are concretized in the museums.

Some challenges seem to be more prevalent in museums than elsewhere in cultural memory institutions or in the enterprises. As the museum related literature mainly focuses on the national level or on the organizational level covering only a few issues, a comprehensive understanding has not been provided. As the museums have mostly been off focus from IS trends; systems development and ICT education, IT experts and programmers do not necessarily have understanding about the museum context. This motivates our study.

3 Research settings and methods

Before diving into the details of research methods and methodological choices, we will present the case setting, museums in Finland.

3.1 Museums in Finland

Finnish museum sector consists of over 1000 museums. We focus on those 331 that are professionally operated under 150 different organizations [45].

Most museums are located in the capital and largest cities. The network covers the entire country and consists of three national museums, 16 national specialized museums, as well as 22 provincial museums and 16 regional art museums. The rest are local museums. Most museums are older than 35 years, and about fifty have already celebrated their 100th anniversary.

Their costs are mainly covered by public funding from the state and municipalities. In 2015, the museum owners invested 245 million euros to the accessibility of physical and digital cultural heritage. Less than 10 % of all costs were covered by private funds. In average, the museums' own income amounts to 15 % [45].

The averages hide two extremes: only five organizations have more than 100 employees, large collections, and a great number of visitors and visibility. About half of the museums are in the other extreme: they have less than 10 employees and smaller collections.

Because of the great heterogeneity by size and by geographical location, we decided to conduct an extensive exploratory survey on a national level and emphasize the perspective of individual museum experts. This provides a more comprehensive view of the challenges that affect digitalization and innovation than by conducting an organization level survey.

3.2 Research methods

Our exploratory survey [46], which enables us to identify previously unknown issues in the context of contemporary museums, consists of two parts. In the first part, we asked the hand-picked group of museum experts to reply two open questions about the use of collections management systems in their work. This was done in the light of a Delphi study cf. [47, 48]. The replies were grouped into 110 statements. In the second part, the same experts prioritized up to 30 most prevalent problems each from the summary.

The survey participants were recruited by snowball sampling among Finnish museum experts. The first author, having 15 years of experience in the museum sector, used her knowledge and identified a group of 40 experts who were contacted either personally or by e-mail, and asked them to nominate experienced colleagues. We were looking for museum directors, senior collections and exhibition curators (i.e. persons in charge of the care, research and management of collections, or planning and implementing exhibitions), IT managers and software providers. The first three groups are involved in the most time-consuming tasks and hands-on practices in museums [49]. IT experts provide a technical perspective. With these suggestions, the number of experts doubled into 82 experts. This list was further complemented by using the Finnish Museum Association's Phonebook. This resulted in 54 new candidates, making the final number to 136.

The characteristics for included museum experts were then defined: at least 3 years of working experience from national, provincial or regional museum or from other national memory organization; and managing national development projects or working as a specialist in collections software development projects. Also, suggestions as one being a "trailblazer" or "innovator" were considered. IT experts were not expected to be employed by the museums but to have experience in working with them.

This criteria left us with 116 candidates who were personally invited to take part in the study by e-mails describing the project, and another having two open questions. 58 experts participated.

Then we sent another letter with a simple open question: When using information systems designed to support museum work, which features facilitate your daily work and/or which make it more difficult? Please list six or more features and explain briefly their consequences to you or to your organization. The 58 responses yielded 395 entries. On average, each museum expert listed 6.8 features.

Neither data collection with open questions nor our data analysis utilized any predefined theoretical lens. The study thus follows exploratory approach [46, 50]. We adopted interpretive qualitative data-driven research approach [51] where we let the data to speak for itself. This took place as follows: the responses were listed on an excel sheet and tagged with initial issues and themes. If an entry contained several issues, it was broken down.

This resulted in 549 issues, from which 205 were positive features facilitating daily work and, hence, excluded because we deliberately studied the problems rendering the experts' work more difficult. This left us with 344 problems. Then similar concepts were merged and categorized. Resulting 12 categories had 10 to 25 problems each, amounting to 110 problems in total. Table 1 gives an example of the process.

Table 1. Illustrative example of our data analysis.

Entry #	Entry	Issue / Themes
80 original	As a person working with exhibitions, I have in general had very little to do with the museum in-formation systems the reason being that the collections management system of my museum has recently been renewed and using the old one required special skill which only the collections ex-perts had.	
80A	As a person working with exhibitions, I have in general had very little to do with the museum information systems for the reason	The system is only in a use of a clique / ways of working
80B	the collections management system of my museum has recently been renewed	Implementation of a new system / technical
80C	and using the old one required special skill	The system is difficult for an occasional user / not user-friendly
80D	Which only the collections expert had. [special skill]	Knowledge is power -attitude of the collections expert / attitudes

In the second round of our survey, we sent these lists to the same experts and asked them to choose 25–30 problems that, in their views, are the biggest challenges in their daily work. We targeted the questionnaire to those 80 experts who had responded positively but not necessarily contributed to the first part. We e-mailed them a link to an online survey where the categories were randomly reorganized for each respondent to reduce potential bias of selecting the first ones. The order of problems within a category; however, remained the same. 60 experts answered, 40 who had also contributed to the first part.

The number of problems each expert identified varied from 9 to 46. Two experts marking 45 and 46 problems were asked to redo their selections. Both came down to 30 problems. Altogether, the average number of problems was 24.

4 Findings

Twelve categories of problems emerged from the data. Each category then comprises a number of problems (challenges). Next, we will discuss them in alphabetical order. Then we will focus on each expert group.

4.1 Attitude (7 unique challenges)

Attitude category covers individual's approach towards colleagues, professional conduct, change, and information technology. In museums, individual attitudes and juxtapositions between traditionalists and trailblazers were evident. For example, [Director 7] articulated "*...Curators ... don't like giving user rights for the museum IS. ... This gives an impression of Curators as gatekeepers, deciding who are those to be allowed to access the IS.*" and "*… every person records the "same" data in a different way... neither do they follow cataloging instructions.*" [Curator 12]

4.2 Skills and competencies (6)

Skills and competencies category considers individual's skills and understanding pertaining to IS and business administration, or the possibility to obtain them. Our results highlight the need for "non-museum understanding" such as IT, IS, business, and project management skills. "*…. Our museum doesn't have an IT expert; instead we, with our liberal arts background, need to deal with issues we know far too little about.*" [Curator 1]. "*Museums do not have enough understanding of business administration to manage negotiations [concerning development and implementation of IS] with different stakeholders.*" [Curator 20].

4.3 Communication (5)

The individuals' approaches to collaboration and communication were most often described as two parties lacking a common language. "*… It's difficult to do business with the IT people because they don't have a clue what are our needs concerning the [museum] IS. We are lacking a common language.*" [Curator 6].

4.4 Content (14)

Content includes the quality and quantity of data and information created, shared, used, and re-used. This was the single most concern of the museum experts. A number of explanations for and dimensions of data quality were brought up, such as understandability of data, dirty data "*… due to the lack of clear [cataloging] rules, cataloging practices have become heterogeneous, so … search[results] are not reliable and "cleaning-up" the*

data fields feels a never-ending chore." [Curator 15]. Also, data aggregation "*[has] been challenging to map the local metadata to the common [transfer] format because the [local] systems use numerous data models.*" [IT Expert 16], and inconsistency of data were considered as problematic since "*… part of the data has been migrated from our previous database to a one we are using now; the information content of the data fields does not always correspond to what it should be. ... all of the above slow down searches and leaves part of the material/data outside the search[results] ...*" [Curator 12]..

4.5 Lack of resources (10)

Museums are lacking various resources; human, financial and physical. [Curator 20] brought up financial issues directly:"*... The cost [of IS] is continuously increasing, maintenance is expensive, and they'll put a figure on every small change. These prices are not always foreseeable. We cannot be prepared for [the price increase]...*" However, this kind of references were rare. Instead, the lack of resources was related to the lack of personnel or time. "*Most of strategic activities, such as research, collecting, and documenting, remain insufficient due to the lack of resources ...*" [Director 4]. "*There are no personnel devoted to museum IS. Those with a responsibility for developing museum databases have to do it in addition to other duties.... No one oversees the crucial IS or monitors the technical developments…on a regular bases. ...*" [Director 12]

4.6 Legal issues (5)

Legal issues cover challenges related to legislation concerning museum work. These challenges are likely to be public sector specific as they are governed by EU and national laws, and by international agreements. Two types emerged from out data: "*Personal privacy act is equally problematic as the copyright law… there is a lot of obscurity how the law should be interpreted when the museums want to publish their data.*" [Curator 19]. Consequently, both unclarity of interpretations and clarity of costs accrued by obeying the law can hold back museums from digitizing. The latter is particularly true for art museums since [Exhibition curator 7]: "*…work relies on images. Current legislation doesn't allow a [digital] exhibition of the copyrighted images of art works outside the physical boundaries of the organization holding the title [without significant copyright charges]*."

4.7 Missing functionality (13)

Missing functionality includes issues where a significant workflow is not supported by the museum IS, for example when cataloging information of photographs: "*There are no functions that would speed up cataloging, such as entering the data of a larger group of objects at once.*" [Curator 12]. It also encompasses entirely unsupported processes such as conservation, exhibition, and loan in/out processes: "*There is no place to enter information regarding the conservation of the object in the IS*." [Director 6].

4.8 Organizational culture (11)

Values, practices, and beliefs and their impact on the organization's ability to change. Organizational culture thus considers challenges related to collaboration, communication, risk, and organizational learning. Our findings show that museums tend to be generally risk averse. Yet, there might be more risk-takers than in average because we particularly looked for trailblazers and innovators. On one hand, the organizational culture have however remained unchanged: "*the work processes in museums are inherently the same as a decade or half a century ago even if the operating environment has completely changed. ...*" [Director 4] and "*the museums are rigid and set in their ways. ...*" [IT Expert 15]. On the other hand, different expert groups admit that there is an inherent strive to do things "my way" which leads to: "*... the lack of common practices and many different collections management systems. ...*" [IT Expert 14] and "*the lack of standards.*" [Curator 22].

4.9 Political issues (7)

Political issues and decision-making affect museums' funding, strategies, and information policies. Changing political winds are likely to be a public sector specific issue. Political decisions, made on the national and municipal levels, were the ones most strongly perceived by our experts. "*...The lack of national coordination and steering of digitization is a major issue, and now [the Ministry] is funding everyone to reinvent the wheel. ...*" [Director 8]. The political issues also emerge on daily activities, since "*[there are] difficulties of developing something native to the museum field: software development projects are done by the [City] IT services. The museum IS doesn't have a high priority there*". [Curator 22].

4.10 Technical issues (9)

Technical challenges ranged from the implementation of a new IS to the bugs and errors in existing systems. Here the challenges varied in how critical or wide-reaching they were. For example, statements such as "*our new IS is on the implementation phase so we have problems with the work in progress, user access ...*"

[Exhibition curator 2], "*we face big problems, year after year. They are the result of migrating information from one system to another...*" [Curator 18], "*there is not only a need to improve the museum IS but also fix different errors and problems. This takes a lot of time*" [Curator 1] and "*... after a software update, we couldn't enter new locations in the database. This happened when we were moving collections to a new warehouse.*" [Curator 23] were common.

4.11 Technical infrastructure (7)

Technical infrastructure category comprises hardware, software, and network resources and services. With these issues, most individual museum experts stated they have little possibilities to do anything by themselves. The decisions are generally made in the municipality (or in the owner organization). The most common issue was the lack of mobile access: " *… if I would list one single thing, it would be getting a remote connection to the [museum's] database, so I could update it from where ever I happen to be.*" [Curator 8]. As museums are a small sector in a municipality, they often felt their needs for special software were ignored: "*The city IS aren't in the development frontline, but old hardware and software are in use.*" [Curator 22]. This ignorance concretized in specific needs, such as when transferring large image and AV files: "*It is a real problem how slowly the systems upload the images and provide information [of search results].*" [Director 3]

4.12 Usability (16)

Many commonly used museum IS are in the end of their life cycle. This was reflected in a number of issues related to their poor Usability. The IT experts articulated this: "*If using the IS needs constant training and users don't know how to use it functions, the system can be too complex. Designing a new user interface would be of great significance.*" [IT Expert 15]. The users agreed and asked for intuitive solutions: "*The system is not particularly user friendly and intuitive.*" [Exhibition curator 2], "*... the logic of the software we use is unnecessarily complex ...*" [Exhibition curator 9], and for better support for their workflows: "*…Entering information [of one object] is scattered over many different pages and forms.*" [Curator 16].

4.13 Four expert perspectives

After identifying these emerging categories, we used them in our second survey to find out a prioritized list of problems perceived by different expert groups. A top twenty list of problems for each of the expert groups is shown in Table 2. The challenges are ordered by importance to illustrate the differences between the groups.

The results show significant differences between the expert groups. Few challenges are related to colleagues' attitude or political decision-making. Instead, information quality and quantity (Content) and organizational culture are emphasized by every group. Usability issues are ranked highest only by the exhibition curators.This is not surprising, since IS are used for managing collections.

One third of the experts were curators. They were from all parts of the country and sizes of organizations The major challenges that set Curators apart from all other groups are their concern of Content (data quality) and the lack of resources, notably the lack of time. Additionally, Attitude was a challenge shared between the curators and museum directors. The former felt that their co-workers have negative attitude towards museum IS, Unwillingness to address these issues affected their daily work. "*Not even museums themselves appreciate*

Table 2. Most significant perceived problems using museum IT by different groups of experts.

	# of problems / category by group of experts						Max # of problems/category
Category	Curator	Exhibit	IT	Director	All	Avg.	#
Content	5	3	4	2	14	3,50	14
Legal issues	2	2	4	4	12	3,00	5
Organizational culture	2	3	3	4	12	3,00	11
Usability	1	6	1	1	9	2,25	16
Communication	2	2	2	2	8	2,00	5
Lack of resources	4	2	0	2	8	2,00	10
Technical issues	2	2	3	1	8	1,25	9
Capabilities	0	1	1	2	4	1,00	6
Missing functionality	1	1	1	0	3	0,75	13
Political issue	0	0	1	1	2	0,50	7
Technical infrastructure	0	0	1	1	2	0,50	7
Attitude	1	0	0	0	1	0,25	7
Total	20	20	20		80	20,00	110

the work done with collections. Collections department often loses the battle of resources to exhibitions and event productions" [Curator 20].

Exhibition curators formed a small and geographically diverse group. They voiced the concerns of the information users but were seldom active in entering information to IS themselves, or providing comments on the systems renewal. This puts Content (data quality) and Organizational culture high on their list of challenges. Exhibition curators stand out from other experts because of the emphasis in poor IT business alignment. This is concretized in the accumulation of six challenges in Usability.

Seasoned IT experts seem to be a scarce resource for Finnish museums. Those few, actually employed in the museums, seldom have a formal IT/IS training, but hold the position because of their personal interest. The "external-to-museum" IT experts typically work in large national projects, in different cultural heritage organizations, or in companies developing IS for museums and other customers.

The issues hindering IT experts revolve around four almost equal categories of challenges: Organizational culture that produces heterogeneous data (Content) that is difficult to aggregate; Technical issues, largely caused by the systems renewal and migrating heterogeneous data; and Legal issues that restrict publishing aggregated data. IT Experts are the only ones not mentioning the lack of resources as a challenge.

Museum directors were mostly from the metropolitan area, of municipal and foundation-owned museums. Similar to IT experts, some directors were not employed by museums but by external organizations, such as national cultural heritage institutions. From one hand, this distances the directors from the everyday life of museums but, from the other, gives them a better overall understanding of the needs of managing museums.

The directors identify Organizational culture and Legal issues as the biggest category of challenges. Directors see themselves only as occasional users of the museum IS, not being confident about their IT skills (Skills and competencies). Yet they often reflect their own Attitudes, admitting to be unwilling to use or to learn the IS. Directors are – of all expert groups – the least concerned about data quality (Content).

5 Discussion

In this paper, we have studied the first steps in developing digital services in museums. We sought understanding how the museums' current collection management systems support digital service creation and what are the main challenges there. Next, we will compare our data-driven findings to previous research in the contexts of industry and digitization.

The quality and quantity of information (Content) impacts most processes in museums. These challenges are largely related to finding the data and assessing its quality, as well as sharing and aggregating information. This affects the quality of expert's own work and decision-making. Since the collections—and information related to them—are the focus of museums, Content issues are emphasized. The problems with heterogeneous and incomplete information, intrinsic to cultural heritage field, have been recognized in earlier studies but from the viewpoint of explaining the historical developments and basic assumption [2, 7]. Our study offers insights about the dimensions of information quality to different expert groups and about the impacts of poor quality. This concern has not been acknowledged in the industry context [8].

Legislation-driven challenges are likely to be public sector specific because of the museums' governance model. Akmon [15] and Navarrete [5] identified the consequences legislation can have in draining resources from digitization projects and argued about wasted digitization investments when digitized material is either withdrawn from the internet or cannot be published due to the fear of possible legal consequences. Our findings parallel these. Earlier the fear of legal consequences affected mainly art museums, reducing the amount of data opened and published in the internet. The new data privacy law may paralyze digitization and innovation also in historical museums. Altogether legislation changes have an impact on IS development and accrue additional costs. They set new requirements for data entries, which, with a large backlog of historical data that do not comply to current laws, makes it very difficult to digitize the collections. In the worst case, existing data is completely withdrawn from the public web sites.

Political decision-making related challenges are missing from innovation literature [8]. Being public organizations, museums are often in the frontline of the battle for resources. Yet this issue has mostly been approached from the economical perspective [5, 13]. Although our findings are in line with problems caused by the changing funding focus, we provide a more complete understanding of the impact of political decision-making on national or municipal levels. The hindrance is not only financial, but extends also to insufficient coordination of local and national level initiatives. As Finnish municipalities are autonomous, they have usually acquired IS and set different working practices by themselves, independently from other organizations. This creates major challenges in data integration on national and international levels [3, 4]. Although the situation is gradually changing, the adoption of international or national standards for museum IS is very slow.

An organization's ability to change is seen as one of the most significant preconditions and drivers for

innovation [8]. In museums, where the focus is hundreds of years instead of a few years, careful balancing is required when embracing newest technology [16]. The need for long-term preservation sets diverse and conflicting information needs. Our results parallel previous studies. The conflict between a strong museum identity and the need to change is evident.

Our findings associated with strong "individual" and organizational cultures prompted an Attitude category. As tens of years of service in the museum is not unusual, many tasks and processes are personified, undocumented, and jealously guarded. This makes the creation of common practices difficult. Also siloed organizations and the lack of common terminology hinder the situation. Altogether the issues of Communication, Attitude, and Organizational culture have been identified with varying levels of detail and terminology earlier [8].

Doerr [7] underlines communication in the context of interdisciplinary, international working groups developing standards for museum IS. Our findings pinpoint two aspects. Firstly, most of the trained IT experts are not employed by the museums. This reduces chances for informal communication and learning. Secondly, museum experts do not lack the motivation to communicate with IT experts but the problem remains in "not knowing how to" communicate with them. Missing a common language points to missing Skills and competencies.

Missing Skills and insufficient training of museum professionals responsible for IT and managing projects is well known [12, 26]. Liberal arts education, traditionally valued in the museum field, has little emphasis on practical management or IT related skills [27, 28]. Our results show that regardless the high educational requirements of museum staff, the competencies tend to be narrow and domain-specific. We thus confirm extant literature and suggest that the lack of competencies, such as (project) management and IT / IS related understanding, forms a significant challenge of digitization and innovation in museums.

Lack of resources seems to be a challenge for both industry and public sector. Coping mechanisms just differ. While [8] discuss various types of resources and how to manage them, our study rather supports [2]'s argument about museums' tight budgets and low levels of funding. Even if the lack of resources can spark innovation, our results indicate four patterns of short-sighted managerial decisions that can further drain the organization's resources. Using trainees or temporary staff for data entry and ad hoc IS projects drains knowledge resources when people leave and can have a negative impact on the Content (data quality) because of unexperienced personnel. Neither enough time is used in evaluating the projects and what can be learned from them, nor adopting international standards and best practices.

Challenges in categories of Technical issues, Usability, Missing functionalities, and Technical infrastructure relate to poor quality IT systems and poor IT-business alignment. They illustrate the confusion of museum experts in an uncommon ground, as for example, usability issues have not been addressed before from the perspective of experts digitizing, entering or analyzing the information. Instead museum visitors and public web-service users have been studied [52].

Finally, some industry specific innovation challenges were absent: innovation process, corporate strategy, and various management and leadership issues. In digitization and museum context, these issues are often discussed on a more general level. They emerge as a variety of information management or project management issues, and are categorized under organizational culture—unlike in industry where management and corporate strategies are significant factors per se [8].

6 Conclusions

In this paper, we have studied how the museums' current collection management systems support digital service creation, and what are the main challenges.

Our data is derived from a two-part survey among museum and IT experts. It reveals twelve different categories of issues when the museums use IS for their activities. Understanding the domain and context where the change initiatives are going to take place is the first step to improve processes, practices, and systems [53]. Hence, identifying the challenges, their instances, and identifying the differences between the expert groups are our main contribution.

First, the categories provide rich insights into the challenges and how individual actors perceive them. This kind of analysis has not been done before as the focus has mostly been on the national and institutional level. Second, the insights improve our understanding about the challenges and possible conflicts between individuals, their museums, municipalities and national level organizations. Third, the analysis illustrates differences in challenges between the groups of experts. Fourth, the impacts of emerging legislation (namely data privacy act) are evident to public sector organizations but will similarly affect all organizations.

Similarly, practitioners can adapt the findings to overcome the problems in practice. For example, the findings can help to target future development endeavors better. This may happen by a more comprehensive system development approach, with a broader set of users and actors, and systems integration [54].

The study has certain limitations. Although the data is derived from several museums and experts, it represents a single country. Hence, the challenges and how they are perceived may differ depending on the context,

governance mechanisms, political situation, and culture. Some of the differences in relation to the previous literature can be explained by the different sizes of museums and the nature of the organizations (public sector vs. industry), while other studies are largely domain specific (e.g. Legal issues, Content). The sample of experts leans towards employees of larger museums (20+ employees) since our experts are seldom working in the smallest organizations. This limits comparability.

Our study sheds light on a little studied topic and organizations. The findings can be used as a basis for developing and conducting e.g. larger quantitative surveys on different countries or domains. As the museums and their practices have evolved over the hundreds of years, the changes caused by digitization and innovation will challenge the whole domain, professions and their existence. Our findings can thus be adopted when studying any organizations with long traditions and history.

References

[1] Sola,T., Redefining collecting, in: Knell, S.J. (ed.), Museums and the future of collecting, 2nd ed., Ashgate, Aldershot, 1998, pp. 250-260.

[2] Sarasan, L. & Neuner, A.M. (ed.). 1983. Museum Collections and Computers. Lawrence, Kansas, Association of Systematics Collections. 292 p.

[3] Ekosaari, M., Tietokoneet museotyössä: suomalaisten taidemuseoiden tiedonhallinnan historia ja nykytila, Computers in Museum work, MA thesis, University of Jyväskylä, 2008.

[4] CSC, Museoiden kokoelmahallintajärjestelmät. Nykytila ja vaihtoehtoiset kehitysmallit. Collections Management Systems in Museums. Final Report. CSC--IT Center for Science Ltd, Espoo, 2011, 80 p.

[5] Navarrete,T., "Becoming Digital: A Dutch Heritage Perspective", The Journal of Arts Management, Law, and Society, 44(3) 2014, pp. 153-168.

[6] Marty,P.F., Information representation, in: Marty, P.F., K.B. Jones (ed.), Museum informatics : people, information, and technology in museums, Routledge, 2008, pp. 29-34.

[7] Doerr,M., "The CIDOC Conceptual Reference Module an Ontological Approach to Semantic Interoperability of Metadata", AI Magazine, 24(3) 2003, pp. 75-92.

[8] Smith,M., M. Busi, P. Ball, R. Van Der Meer, "Factors influencing an organisation's ability to manage innovation: a structured literature review and conceptual model", Int. Journal of innovation management, 12(4) 2008, 655-676.

[9] Riley-Reid,T.D., "The hidden cost of digitization – things to consider", Collection Building, 34(3) 2015, 89-93.

[10] Blanchard, P., J. Huiban, A. Musolesi, P. Sevestre, "Where there is a will, there is a way? Assessing the impact of obstacles to innovation", Industrial and Corporate Change, 22(3) 2013, pp. 679.

[11] Lopatin,L., "Library digitization projects, issues and guidelines: A survey of the literature", Library Hi Tech, 24(2) 2006, pp. 273-289.

[12] Urban,R.J., "Library Influence on Museum Information Work", Library Trends, 62(3) 2014, pp. 596-612.

[13] Bell,B., "Canadiana.org: One of Canada's oldest and newest digitization initiatives", Partnership: the Canadian Journal of Library and Information Practice and Research, 3(1) 2008, pp. 1-4.

[14] Dougherty,D., C. Hardy, "Sustained Product Innovation in Large, Mature Organizations: Overcoming Innovation-to-Organization Problems", The Academy of Management Journal, 39(5) 1996, pp. 1120-1153.

[15] Akmon, D., "Only with your permission: how rights holders respond (or don't respond) to requests to display archival materials online", Archival Science, 10(1) 2010, pp. 45-64.

[16] Marty,P.F., An Introduction to museum informatics, in: Marty, P.F., K.B. Jones (ed.), Museum informatics : people, information, and technology in museums, Routledge, New York, 2008, pp. 3-8.

[17] Edwards,T., G. Battisti, A. Neely, "Value creation and the UK economy: a review of strategic options", International Journal of Management Reviews, 5-6 (3-4) 2004, pp. 191-213.

[18] Burda,D., F. Teuteberg, "Sustaining accessibility of information through digital preservation: A literature review", Journal of Information Science, 39(4) 2013, pp. 442-458.

[19] Manzuch,Z., "Monitoring digitisation: lessons from previous experiences", Journal of Documentation, 65(5) 2009, pp. 768-796.

[20] Hughes, L.M., Digitizing collections: strategic issues for the information manager, Facet Publishing, 2004, 315 p.

[21] Cameron,F., S. Mengler, "Complexity, Transdisciplinarity and Museum Collections Documentation: Emergent Metaphors for a Complex World", Journal of Material Culture, 14(2) 2009, pp. 189-218.

[22] Brancolini,K.R., "Selecting research collections for digitization: Applying the Harvard model", Library Trends, 48(4) 2000, Baltimore pp. 783.

[23] Dallas,C., "Digital curation beyond the “wild frontier”: a pragmatic approach", Archival Science, 16(4) 2016, 421-457.

[24] Benardou,A., P. Constantopoulos, C. Dallas, D. Gavrilis, "Understanding the Information Requirements of Arts and Humanities Scholarship", International Journal of Digital Curation, 5(1) 2010, pp. 18-33.

[25] Marty,P.F.,"Unintended Consequences: Unlimited Access, Invisible Work and the Future of the Information Profession in Cultural Heritage Organizations", 38(3) 2012, 27-31.

[26] Marty,P.F., N.D. Alemanne, "Engaging the Experts in Museum Computing: Seven Years of Queries on MCN-L", 56(4) 2013, pp. 421-433.

[27] Howard,K., Educating Cultural Heritage Information Professionals for Australia’s galleries, libraries, archives and

museums: A Grounded Delphi study, Queensland University of Technology Science and Engineering, 2015, 334 p.

[28] Mitchell, R., R. Fisher, Professional managers for the arts and culture?: The training of cultural administrators and arts managers in Europe : trends and perspectives, Arts Council of Finland, Helsinki, 1992, 202 p.

[29] Anderson, C., D. Maxwell, Starting a digitization center, Elsevier, Amsterdam, 2004, 208 p.

[30] Chenhall, R.G., D. Vance, Museum Collections and Today's Computers, Greenwood Press Inc, CT, 1988, 169 p.

[31] Huvila,I., "How a museum knows? Structures, work roles, and infrastructure of information work", Journal of the American Society for Information Science and Technology, 64(7) 2013, pp. 1375.

[32] Srinivasan,R., R. Boast, J. Furner, K.M. Becvar, "Digital Museums and Diverse Cultural Knowledges: Moving Past the Traditional Catalog", Information Society, 25(4) 2009, 265-278.

[33] Peacock,D., The information revolution in museums, in: Marty, P.F., K.B. Jones (ed.), Museum informatics: people, information, and technology in museums, Routledge, New York, 2008, pp. 59-76.

[34] Zorich,D.M., Information Policy in Museums, in: Marty, P.F., K.B. Jones (ed.), Museum informatics: people, information, and technology in museums, Routledge, 2008, 85-106.

[35] Purday,J., "Think culture: Europeana.eu from concept to construction", The Electronic Library, 27(6) 2009, 919-937.

[36] Loebbecke,C., M. Thaller, Preserving Europe's Cultural Heritage in the Digital World, Proceedings of ECIS 2005, Regensburg, Germany, May 2005 .

[37] Roel,E., "The MOSC Project: Using the OAI-PMH to Bridge Metadata Cultural Differences across Museums, Archives, and Libraries", Information Technology and Libraries, 24(1) 2005, pp. 22.

[38] Cameron,F.,"Digital Futures I: Museum Collections, Digital Technologies, and the Cultural Construction of Knowledge", Curator: Museum Journal, 46(3) 2003, pp. 325-340.

[39] Hyvönen,E., K. Viljanen, J. Tuominen, K. Seppälä, Building a National Semantic Web Ontology and Ontology Service Infrastructure –The FinnONTO Approach, in: Anonymous (ed.), Springer Berlin Heidelberg, 2008, pp. 95-109.

[40] Valkeapää,O., O. Alm, E. Hyvönen, Efficient Content Creation on the Semantic Web Using Metadata Schemas with Domain Ontology Services (System Description), in: Anonymous (ed.), Springer 2007, pp. 819-828.

[41] Mohnen,P, L. Röller,"Complementarities in innovation policy", European Economic Review, 49(6) 2005, 1431-1450.

[42] Peffers,K., C.E. Gengler, T. Tuunanen, "Extending Critical Success Factors Methodology to Facilitate Broadly Participative Information Systems Planning", Journal of Management Information Systems, 20(1) 2003, pp. 51-85.

[43] Tuunainen,V.K., T. Tuunanen, "IISIn - A Model for Analyzing ICT Intensive Service Innovations in n-Sided Markets", 2011 44th Hawaii International Conference on System Sciences, Hawaii, USA, Jan 2011, IEEE, pp. 1-10.

[44] Zolnowski,A., C. Weiss, T. Bohmann, Representing Service Business Models with the Service Business Model Canvas -- The Case of a Mobile Payment Service in the Retail Industry, 2014 47th Hawaii International Conference on System Sciences, Hawaii, USA, Jan 2014, IEEE, pp. 718-727.

[45] Liukkonen, E, A. Niemelä (ed.), Museotilasto 2015, Museum Statistics of 2015, Museovirasto, Helsinki, 2016, .

[46] Reiter,B., The Epistemology and Methodology of Exploratory Social Science Research: Crossing Popper with Marcuse, in: Reiter, B. (ed.), The Dialectics of Citizenship : Exploring Privilege, Exclusion, and Racialization, Michigan State University Press, East Lansing, MI, 2013, pp. 26-47.

[47] Okoli,C., S.D. Pawlowski, "The Delphi method as a research tool:an example, design considerations and applications", Information & Management, 42(1) 2004, pp. 15-29.

[48] Päivärinta,T., S. Pekkola, C. Moe, Grounding Theory from Delphi Studies (December 5, 2011). ICIS 2011 Proceedings, 4.-7.12.2011, AIS, Atlanta, GA, pp. 1-14.

[49] Kallio,K., Kallio's analysis on Museoväki '13 (Museum people '13), Finnish Museums Association, Helsinki, 2013.

[50] Bélanger,F., L. Carter, "Digitizing Government Interactions with Constituents: An Historical Review of E-Government Research in Information Systems", Journal of the Association for Information Systems, 13(5) 2012, pp. 363.

[51] Walsham,G., "Doing interpretive research", European journal of information systems, 15 (3) 2006, pp. 320-330.

[52] Kumpulainen,S., H. Kautonen, Accidentally Successful Searching: Users' Perceptions of a Digital Library, Proceedings of the 2017 Conference on human information interaction and retrieval, 07-11.3.2017, ACM, New York, pp. 257-260.

[53] Andrew H. Van de Ven, K. Sun, "Breakdowns in Implementing Models of Organization Change", Academy of Management Perspectives, 25(3) 2011, Briarcliff Manor pp. 58-74.

[54] Iivari,J., H. Isomäki, S. Pekkola, "The user - the great unknown of system development: reasons, forms, challenges, experiences and intellectual contributions of user involvement", Information Systems Journal, (20) 2, 2010, 109-117.